

--	--	--	--	--	--	--	--	--	--

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2022/2023

BST1034 – STATISTICS FOR MANAGERS

(All Sections / Groups)

04 OCTOBER 2023

9:00 a.m. – 11:00 a.m.

(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 8 printed pages excluding the cover page, with 4 questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Students are allowed to use non-programmable scientific calculators (without restriction).
4. All necessary workings must be shown and please write all your answers in the answer booklet provided.

QUESTION 1:

- a. The following data presents the prices (in RM) of a sample of ten rice cookers sold by a shop last week.

78 560 92 150 100 88 680 188 240 166

- i. Determine the median of the data. (3 marks)
 - ii. Describe the shape of the data. (2 marks)
 - iii. Calculate the standard deviation of the data. (5 marks)
- b. Two suppliers, A and B, supplied 64% and 36% of the rice cookers of a shop. However, the manager of the shop found that 1% and 2% of the rice cookers supplied by suppliers A and B, respectively, have defects.
- i. If a rice cooker bought by a customer has defects, what is the probability that the rice cooker is supplied by supplier B? (4 marks)
 - ii. If a rice cooker bought by a customer is in good condition, what is the probability that the rice cooker is supplied by supplier A? (4 marks)
- c. The retail prices of different brands of rice cookers are known to be normally distributed with a mean of RM180 and a standard deviation of RM60.
- i. What is the probability that the retail price of a rice cooker is between RM150 and RM240? (4 marks)
 - ii. Find the retail price such that only 10% of the rice cookers will be priced higher than this price. (3 marks)

(Total: 25 Marks)

Continued.....

QUESTION 2:

- a. A restaurant uses customer satisfaction scores (scale from 0 to 10) to measure how well its staff serve their customers. It is given that the population standard deviation of all customer satisfaction scores is 1.50. The following random sample are the scores rated by 12 customers who visited the restaurant this week:

10 9 7 6 8 7 9 10 7 10 10 8

- Compute the sample mean customer satisfaction scores. (3 marks)
 - Construct a 95% confidence interval for the average customer satisfaction scores rated by all the customers this week. (5 marks)
 - If the average customer satisfaction score last week was 8.20. Test at 1% significance level whether the average customer satisfaction score has increased this week. (8 marks)
- b. The following data presents the respective sample mean of monthly electricity consumption per household ($\bar{x}$, in MWh), the population variance of the electricity consumption (σ), and the number of households (n) in two nearby residential areas:

Town A	Town B
$\bar{x}_A = 26.6$	$\bar{x}_B = 24.4$
$\sigma_A^2 = 18.2$	$\sigma_B^2 = 17.9$
$n_A = 220$	$n_B = 260$

At the 5% significance level, can we conclude that there is a significant difference in the mean monthly household electricity consumption between the two residential areas? (9 marks)

(Total: 25 Marks)

Continued.....

QUESTION 3:

- a. A chain restaurant owner would like to know if there is a difference in the mean customer satisfaction scores of its chain restaurants. The following partially completed ANOVA table is obtained from a random sample of customers who visited the restaurants last month:

Source of Variation	Sum of Squares	<i>df</i>	Mean of Squares
Between Groups	5.920	4	***
Within Groups	***	***	***
Total	652.384	186	

- Complete the ANOVA table. (2 marks)
 - If the customer satisfaction scores rated by all the customers are normally distributed and have equal variances, can the owner claim that there is no difference in the mean customer satisfaction scores of its five chain restaurants at the 5% significance level? (8 marks)
- b. The chain restaurant owner would also like to know if there is a relationship between customer satisfaction scores (0 to 10) and food serving time (in minutes). The data from 110 randomly selected customers is presented in the following table:

Customer satisfaction score	Food serving time		
	0 – 20	21 – 40	41 – 60
0.0 – 2.5	5	8	16
2.6 – 5.0	6	9	10
5.1 – 7.5	10	10	8
7.6 – 10.0	15	8	5

Is there a relationship between the customer satisfaction score and food serving time at the 5% significance level? (15 marks)

(Total: 25 Marks)

Continued.....

QUESTION 4:

- a. The manager of a restaurant posits that the average monthly customer satisfaction scores (scale from 0 to 10) rated by its customer have an effect on its monthly revenue of the restaurant (in RM thousands). The following is a random sample of monthly data:

Score, X	8.5	8.8	8.4	8.4	7.4	7.6	7.2	8.9	8.0	8.0	7.9	8.2
Revenue, Y	32	40	36	38	26	20	18	42	32	30	29	34

- Compute the coefficient of correlation. (3 marks)
 - Find the regression line of the. (5 marks)
- b. The following is the partially completed ANOVA table of the monthly revenue of a restaurant regressed on four independent variables:

Source of Variation	<i>SS</i>	<i>df</i>	<i>MS</i>
Regression	***	4	**
Residual	1277.76	**	**
Total	1297.12	124	

- Complete the ANOVA table. (2 marks)
 - Test whether the regression model is statistically significant at 10% significance level. (7 marks)
- c. The following are the prices (per kilogram) and quantities (in kilograms) of five type of vegetables purchased by a restaurant for the year 2021 and 2022:

Type of vegetable	Year (2021)		Year (2022)	
	Price (RM)	Quantity	Price (RM)	Quantity
Broccoli	5.8	1668	7.3	2204
Cabbage	3.5	1502	4.0	1760
Carrots	3.8	1325	4.5	1380
Potato	3.2	2346	4.6	1978
Lettuce	4.3	1224	4.8	1183

- Calculate a Paasche aggregate price index for the year 2022, using 2021 as the base year. (3 marks)
- Calculate a Laspeyres aggregate price index for the year 2022, using 2021 as the base year. (3 marks)
- Calculate the Fisher's Ideal Price Index for the year 2022. (2 marks)

(Total: 25 Marks)

Continued.....

APPENDIXES:**I. STATISTICAL FORMULAE****A. DESCRIPTIVE STATISTICS****Ungrouped Data:**

$$\text{Sample Mean, } \bar{x} = \frac{\sum x}{n} \quad \text{Sample Standard Deviation, } s = \sqrt{\frac{\sum x^2}{n-1} - \frac{(\sum x)^2}{n(n-1)}}$$

Grouped Data:

$$\text{Sample Mean, } \bar{x} = \frac{\sum fx}{\sum f} \quad \text{Sample Standard Deviation, } s = \sqrt{\frac{\sum fx^2}{\sum f - 1} - \frac{(\sum fx)^2}{\sum f(\sum f - 1)}}$$

$$\text{Median} = L_m + \left[\frac{\left(\frac{\sum f}{2} - F_{m-1} \right)}{f_m} \right] c \quad \text{Mode} = L_m + \left[\frac{(f_m - f_{m-1})}{2f_m - f_{m-1} - f_{m+1}} \right] c$$

B. PROBABILITY DISTRIBUTION**Poisson Probability Distribution**

$$\text{If } X \text{ follows a Poisson Distribution } P(\lambda) \text{ where } P(X = x) = \frac{\lambda^x e^{-\lambda}}{x!}$$

then the mean = $E(X) = \lambda$ and variance = $\text{VAR}(X) = \lambda$

Binomial Probability Distribution

$$\text{If } X \text{ follows a Binomial Distribution } B(n, p) \text{ where } P(X = x) = {}^n C_x p^x q^{n-x}$$

then the mean = $E(X) = np$ and variance = $\text{VAR}(X) = npq$ where $q = 1-p$

Normal Distribution

$$\text{If } X \sim N(\mu, \sigma) \text{ where } E(X) = \mu \text{ and } \text{VAR}(X) = \sigma^2, \text{ then } Z = \frac{X - \mu}{\sigma}$$

C. CONFIDENCE INTERVAL ESTIMATION AND SAMPLE SIZE DETERMINATION

$$\text{If } \sigma \text{ known, } (100-\alpha)\% \text{ Confidence Interval for Population Mean, } \mu: \bar{x} \pm Z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$$

$$\text{If } \sigma \text{ unknown, } (100-\alpha)\% \text{ Confidence Interval for Population Mean, } \mu: \bar{x} \pm t_{\alpha/2, n-1} \frac{s}{\sqrt{n}}$$

$$(100-\alpha)\% \text{ Confidence Interval for Population Proportion, } p: p \pm Z_{\alpha/2} \sqrt{\frac{p(1-p)}{n}}$$

$$\text{Sample Size Determination for Population Mean: } n \geq \frac{(Z_{\alpha/2})^2 \sigma^2}{E^2}$$

$$\text{Sample Size Determination for Population Proportion: } n \geq \frac{(Z_{\alpha/2})^2 p(1-p)}{E^2}$$

Continued.....

D. HYPOTHESIS TESTING**One Sample Mean Test**

$$\text{Z-test: } Z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$$

$$\text{t-test: } t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$$

One Sample Proportion Test

$$Z = \frac{p - \pi}{\sqrt{\frac{\pi(1 - \pi)}{n}}}$$

Two Sample Mean Test

$$\text{Z-test: } Z = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

$$\text{t-test: } t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{s_p \sqrt{\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \quad \text{where } s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

Two Sample Proportion Test

$$Z = \frac{(p_1 - p_2) - (\pi_1 - \pi_2)}{\sqrt{\bar{p}(1 - \bar{p}) \left[\frac{1}{n_1} + \frac{1}{n_2} \right]}} \quad \text{where } \bar{p} = \frac{x_1 + x_2}{n_1 + n_2}$$

E. ANALYSIS OF VARIANCE

$$SST = \sum_{i=1}^k \sum_{j=1}^{n_j} (X_{ij} - \bar{\bar{X}})^2 \quad SSB = \sum_{i=1}^k n_i (\bar{X}_i - \bar{\bar{X}})^2$$

$$SSW = \sum_{i=1}^k (n_i - 1) s_i^2 \quad \text{or} \quad SSW = \sum_{i=1}^k \sum_{j=1}^{n_j} (x_{ij} - \bar{x}_i)^2$$

F. CHI-SQUARE ANALYSIS

$$\text{Expected cell frequencies for Independent Test: } E_i = \frac{\text{Row total} \times \text{Column total}}{N}$$

$$\text{Chi-Square test statistic: } \chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

O_i = Observed frequency in a particular cell

E_i = expected frequency in a particular cell

Continued.....

G. REGRESSION ANALYSIS

Correlation Coefficient:
$$r = \frac{n \sum xy - \sum x \sum y}{\sqrt{[n \sum x^2 - (\sum x)^2][n \sum y^2 - (\sum y)^2]}}$$

Simple Linear Regression: $Y = a + bX$ where $b = \frac{\sum xy - \frac{\sum x \sum y}{n}}{\sum x^2 - \frac{(\sum x)^2}{n}}$ and $a = \bar{y} - b\bar{x}$

H. INDEX NUMBERS

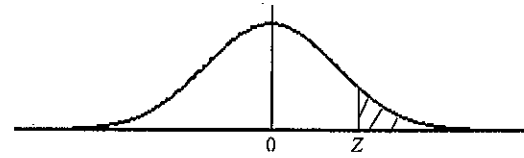
Simple Price Index $P = \frac{p_t}{p_0} \times 100$	Laspeyres Quantity Index $P = \frac{\sum p_0 q_t}{\sum p_0 q_0} \times 100$
Simple Aggregate Price Index $P = \frac{\sum p_t}{\sum p_0} \times 100$	Paasche Quantity Index $P = \frac{\sum p_t q_t}{\sum p_t q_0} \times 100$
Laspeyres Price Index $P = \frac{\sum p_t q_0}{\sum p_0 q_0} \times 100$	Fisher's Ideal Price Index $\sqrt{(\text{Laspeyres Price Index})(\text{Paasche Price Index})}$
Paasche Price Index $P = \frac{\sum p_t q_t}{\sum p_0 q_t} \times 100$	Value Index $V = \frac{\sum p_t q_t}{\sum p_0 q_0} \times 100$

Continued.....

II. STATISTICAL TABLE

Table 1

The Upper Tail Area Under the Standard Normal Curve



Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
3.5	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
3.6	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
3.7	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
3.8	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
3.9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

End of Page